

MIL-F-81334B(AS)

5 July 1977

Superseding

MIL-F-81331A(AS)

1 May 1969

MILITARY SPECIFICATION

FOAM, PLASTIC, FLEXIBLE, OPEN CELL
POLYESTER TYPE, POLYURETHANE

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers flexible, open cell, polyester type, polyurethane foam. (See 6.1)

1.2 Classification.

1.2.1 Grade. The materials furnished shall be of the following grades:

Grade I Four pounds per cubic foot density

Grade II Six pounds per cubic foot density

1.2.2 Form. The material shall be furnished in the following forms:

Sheet
Strip
As ordered (shapes)

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS

FEDERAL

MMM-A-1617 Adhesive, Rubber, General Purpose

PPP-B-601 Box, Wood, Cleated, Plywood

PPP-B-636 Box, Shipping, Fiberboard

MILITARY

MIL-P-116 Preservation; Methods of

MIL-H-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance

MIL-L-23699 Lubricating Oil, Aircraft Turbine Engines, Synthetic Base

MIL-M-81288 Mounting Bases, Flexible Plastic Foam

STANDARDS

MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129 Marking for Shipment and Storage

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other Publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 412-75 Tests for Rubber Properties in Tension

ASTM D 1564-71 Testing Flexible Cellular Materials - Slab Urethane Foam

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ASTM D 1692-74 Test for Rate of Burning or Extent of Burning of Cellular Plastics Using a Supported Specimen by a Horizontal Screen

ASTM F 74-73 Determining Hydrolytic Stability of Plastic Encapsulants for Electronic Devices

(Application for copies should be addressed to the American Society For Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.)

3. REQUIREMENTS

3.1 First article. Unless otherwise specified, the polyurethane foam furnished under this specification shall be a product which has passed the first article inspection specified herein.

3.2 Material. The flexible, open cell polyester polyurethane foam shall be formed by the addition polymerization of diisocyanate and polyhydroxy compounds. Polyesters shall be used as hydroxyl terminating groups. The finished material shall consist of a network of predominantly open and interconnecting cells of uniform size and character.

3.2.1 Color - Unless otherwise specified (see 6.2), the color shall be as supplied.

3.2.2 Finish - Unless otherwise specified (see 6.2), all surfaces shall be cut-finished.

3.2.3 Form - The material furnished under this specification shall be in the form of sheets, strips, or as ordered (see 6.2).

3.3 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate departmental medical service who will act as an advisor to the procuring activity.

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3.4 Properties. The finished foam properties shall be as specified in Table I.

TABLE I. PHYSICAL PROPERTIES

PROPERTY	REQUIREMENT		TEST PARA.
	GRADE 1	GRADE 2	
Density, pounds/cubic feet	4 ± 0.3	6 ± 0.3	4.6.2
Tensile strength, psi, min	30	25	4.6.3
Elongation, %, ± 100	450	400	4.6.3
Tear resistance, pounds, min	4.5	4.0	4.6.4
	ALL GRADES		
Pore openings, pores/linear inch	60 ± 10		4.6.5
Flame resistance	Self extinguishing within 10 sec. No burning on foil		4.6.6
Compression set, %, max	10		4.6.7
Resilience, % recovery of original thickness	95		4.6.8
Properties after high temperature exposure, max % change from original values			4.6.9
Compression set	25		
Tensile strength	25		
Elongation	25		
Die cut resistance, % recovery of initial thickness	95 - No fusion of pores		4.6.10
Steam autoclave, properties after, max % change from orig. value			4.6.11
Compression set	15		
Tensile strength	15		
Fluid resistance, properties after, max % change from orig. values			4.6.12
Tensile strength	10		
Elongation	10		

TABLE I (Continued)

PROPERTY	REQUIREMENT ALL GRADES	TEST PARA.
Load deflection	All portions of curve within 15% of nominal Curve of Figure 1	4.6.13
Low temperature vibration	No tearing. Transmissibility shall not exceed that of Figure 2	4.6.14
Hydrolytic stability, extrapolated lifetime at 23°C (73.4°F), minimum	7 years	4.6.15

3.5 Age restrictions. The flexible polyurethane foam shall not be older than 6 months from the date of manufacture when shipped for delivery to the Government.

3.6 Workmanship The flexible polyurethane foam shall be a product manufactured by such processes as to meet all the requirements of this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

1. First article inspection (see 4.3)
2. Quality conformance inspection (see 4.4)

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4.3 First article inspection. When specified (see 4.3.1 and 6.2), first article inspection shall consist of all the tests, examinations and inspections of this specification. Instructions as to testing and approving the first article shall be as specified in 6.

4.3.1 Prior approval. First article inspection or any part thereof, may be waived, at the discretion of the procuring activity when it has been determined that the polyurethane foam is from a previously approved batch.

4.3.2 Product changes Changes in formulation, composition or production techniques shall be cause to reinspect the polyurethane foam product to all the requirements of this specification.

4.3.3 First article sample. First article sample shall consist of 3 sheets of foam 1 foot by 2 foot by 1 inch thick. The sample shall have been produced in the same facility intended for the contract production run. The first article sample shall be identified by labels or tags attached in a manner which will not affect the sample. The label or tag shall contain the following information:

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Sample for first article inspection

Foam, Plastic, Flexible, Open Cell, Polyester Type, Polyurethane

Name of manufacturer

Name of distributor (when applicable)

Manufacturer's product designation

Date of manufacture

4.3.4 Manufacturer's data The manufacturer shall submit test reports which show the product furnished complies with all the requirements contained herein.

4.4 Quality conformance.

4.4.1 Lot formation. Unless otherwise specified, a lot shall consist of all the polyurethane foam produced under essentially the same manufacturing conditions, at one plant designated a batch, and offered for inspection at one time. Unless otherwise specified, the lot size shall be expressed as the total number of yards supplied.

4.4.2 Sampling.

4.4.2.1 Visual. Sample size shall be determined in accordance with Inspection Level II of MIL-STD-105. The unit of product shall be two square feet. The samples shall be randomly selected from the material supplied. Inspection shall be as specified in 4.4.3.1.

4.4.2.2 Physical properties. A quantity of foam sufficient to perform tests specified in 4.4.3.2 shall be randomly selected from each lot submitted for inspection.

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4.4.2.3 Packaging. A quantity of shipping containers fully packed, just prior to closure, shall be randomly selected from each lot in accordance with Inspection Level II of MIL-STD-105. The unit of product shall be one shipping container and the lot size shall be the number of shipping containers. Inspection shall be as specified in 4.4.3.3.

4.4.3 Inspections.

4.4.3.1 Visual. Units of product selected in 4.4.2.1 shall be examined for defects as specified in Table II. The Acceptable Quality Level (AQL) for this inspection shall be 1.0 defects per 100 units.

TABLE II. VISUAL INSPECTION

Examination	Defect
Appearance	Sample gouged, torn, or otherwise damaged to prevent acceptance. Not as specified
Finish	
Marking	

4.4.3.2 Physical properties. Samples selected in 4.4.2.2 shall be examined to the properties in Table III. Failure of any test specimen to meet the requirements specified herein shall be cause to reject the lot represented by the specimen.

TABLE III. PHYSICAL PROPERTY INSPECTION

Property	Requirement	No. of test specimens	Results reported as
Density	Table I	2	pass or fail
Pore openings	Table I	5	pass or fail
Load deflection	Table I	3	pass or fail
Compression set	Table I	3	Average <u>1/</u>

1/ All test values shall be reported and be within the requirements of Table I

4.4.3.3 Packaging. Samples selected in 4.4.2.3 shall be examined to the requirements of Table IV and all other requirements in Section 5. The Acceptable Quality Level (AQL) for this inspection shall be 2.5 defects per 100 units.

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TABLE IV. PACKAGING EXAMINATION

Examine	Defect
Packing (all forms)	<p>Not level specified; not in accordance with contract requirements</p> <p>Container not as specified; closures not accomplished by specified or required methods or materials</p> <p>Any nonconforming component; component missing, damaged, or otherwise defective affecting serviceability</p> <p>Inadequate application of components, such as: incomplete closures of case liners, container flaps, loose ends</p>

4.5 Standard conditions. Unless otherwise specified, all test samples shall be conditioned at $23 \pm 1.1^{\circ}\text{C}$ ($73.5 \pm 2^{\circ}\text{F}$) and 50 ± 4 percent relative humidity prior to testing.

4.6 Test methods.

4.6.1 Appearance. The color, finish, and form of the foam shall be visually examined to the requirements of 3.2 and related subparagraphs.

4.6.2 Density. The density shall be determined in accordance with ASTM D 1564-71 using a 0.5 cubic foot specimen.

4.6.3 Tensile strength and elongation. Tensile strength and elongation determinations shall be made in accordance with ASTM D 1564-71.

4.6.4 Tear resistance. The material shall be tested in accordance with ASTM Method 1564-71.

4.6.5 Pore openings. The number of pore openings shall be visually determined at 10 power magnification. Photographs taken with a super-imposed grid may be used to facilitate the measurement of the number of openings.

4.6.6 Flame resistance. Flammability characteristics shall be determined in accordance with ASTM D 1692-74. Time shall be counted at instant of flame removal.

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4.6.7 Compression set. The compression set of the polyurethane foam shall be determined in accordance with ASTM D 1564-71. Specimens shall be deflected 50 percent.

4.6.8 Resilience. The resilience (immediate recovery after compression) of the foam shall be determined as specified in Suffix D of ASTM D 1564 except that the compression shall be maintained only one (1) minute at standard conditions. The specimen shall be re-measured immediately upon removal from the compression apparatus. Percent recovery of original thickness shall be in accordance with the requirement in Table I.

4.6.9 High temperature resistance. Tensile strength and compression set specimens shall be prepared and exposed in an air circulating oven at $140 \pm 1^\circ\text{C}$ ($284 \pm 2^\circ\text{F}$) for 22 hours. The specimens shall be cooled to standard conditions, then tested for tensile strength, elongation and compression set as specified in 4.6.3 and 4.6.7 respectively. Percent change from original values shall be reported.

4.6.10 Die cut resistance. Three specimen shall be die-cut at ambient conditions as specified in ASTM D 412 using die "C". Each specimen shall be measured to determine percent recovery of original thickness and then visually examined for evidence of fusion.

4.6.11 Steam autoclave. Three compression set specimens (4.6.7) shall be placed in an autoclave and exposed as follows:

- Grade I specimens - 15 pounds per square inch for 2 hours
- Grade II specimens - 15 pounds per square inch for 3 hours

Test specimens shall be removed from the autoclave and dried in a circulating air oven at $70 \pm 1^\circ\text{C}$ ($158 \pm 2^\circ\text{F}$) for 1 hour, then conditioned at standard conditions (4.5) for 24 hours before testing for compression set as specified in 4.6.7. Percent change from original compression set values shall be reported.

4.6.12 Fluid resistance. Three tensile strength specimens shall be completely immersed in hydraulic fluid conforming to MIL-H-5606 and three specimens in lubricating fluid conforming to MIL-L-23699. Immersion time at standard conditions shall be one (1) hour $\pm 5, -0$ minutes. The specimens shall be removed from the fluid, the excess fluid removed and tested as specified in 4.6.3. Percent change from original tensile strength and elongation values shall be reported.

4.6.13 Load deflection. Three specimens, 5 by 5 by 1 inch ($\pm 1/16$ inch all dimensions), shall be prepared. A uniform compressive load shall be applied to three (3) specimens over the range from zero load to that load which results in a specimen deflection of 70 percent.

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Loading may be continuous or incremental, but for every measured load value the specimen deflection shall be measured. A graph of unit load (in pounds per square inch) vs. deflection in inches of unloaded foam thickness shall be made using the average of three specimens. The plot of compressive load shall be in agreement with the requirement in Table I.

4.6.14 Vibration at low temperature - The test specimen shall consist of a foam pad, 6 by 8 by 1.0 inch thick, cemented, using adhesive conforming to MIL-A-1617, between two aluminum plates. A load of 16 pounds, measuring 6 by 8 inches, of uniform density and thickness, shall be secured to the upper plate. The dimension tolerance shall be $\pm 1/16$ inch. The lower plate shall be rigidly mounted on a vibration platform in its upright attitude. The temperature of the ambient air in an enclosure surrounding the test specimen shall be reduced to $-40 \pm 1^\circ\text{C}$ ($-40 \pm 2^\circ\text{F}$) and allowed to stabilize for 1 hour. An input of simple harmonic motion shall be applied along the vertical axis only. The frequency shall be varied uniformly between 5 and 500 cps. The entire range of frequencies from 5 to 500 cps and return to 5 cps shall be transversed. The applied vibration amplitude shall be in accordance with Figure 3. The response shall be measured along the vertical axis only. The test specimen shall be vibrated for two hours along the vertical axis only at the predominant resonant frequency, in accordance with Figure 3.

4.6.15 Hydrolytic stability. Hydrolytic stability of the foam shall be determined in accordance with ASTM F 74-73 and the following:

4.6.15.1 Procedure. Tensile specimens shall be prepared as specified in ASTM D 1564-71. Five specimens shall be tested to determine the initial data point (zero time) for all exposure temperatures. Twenty specimens shall be placed in the hydrolytic chamber and exposed at $97 \pm 1^\circ\text{C}$ ($206.6 \pm 2^\circ\text{F}$). Five specimens shall be removed at each of four specific time intervals to determine the data points. The specimens shall be conditioned at standard conditions (4.5) for 2 hours before tensile tests in accordance with ASTM D 1564-71. This procedure shall be repeated at additional exposure temperatures of $85 \pm 1^\circ\text{C}$ ($185 \pm 2^\circ\text{F}$) and $71 \pm 1^\circ\text{C}$ ($160 \pm 2^\circ\text{F}$).

4.6.15.2 Reporting of results. The average value for each data point shall be plotted against time on rectangular coordinate paper. The exact failure time at each exposure temperature shall be determined by interpolation to 5 psi, the theoretical failure data point. Each failure time (one for each temperature) shall be plotted against its respective exposure temperature as specified in ASTM D 74-73, then extrapolated to 23°C (73.4°F). The service time in years shall conform to the requirement in Table I.

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5. PACKAGING.

5.1 Packaging. Packaging shall be Level A or C as specified (See 6.2)

5.1.1 Level A. Unless otherwise specified, the foam shall be packaged in accordance with Method III of MIL-P-116. Sheets, strips or as ordered shapes shall be packaged in containers conforming to PPP-B-636, Type CF, Class Weather Resistant, Grade V3c or PPP-B-601, overseas type. Closure and waterproofing shall be in accordance with the applicable specification appendix. Foam sheets shall be separated with paper or other suitable separating sheets.

5.1.2 Level C. The foam shall be packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be Level A, B, or C as specified.

5.2.1 Levels A and B. Foam packaged as specified in 5.1.1 requires no further overpacking.

5.2.2 Level C. The material packaged in accordance with 5.1.2 shall be packed to afford protection against damage during direct shipment from the source of supply to the first receiving activity for immediate use. Containers shall comply to the Uniform Freight Classification Rules or other regulations applicable to the mode of transportation.

5.3 Marking. Each container shall be marked in accordance with MIL-STD-129. Marking shall include, but not be limited to, the following information:

- (1) Manufacturer's name and location
- (2) Material trade name
- (3) Net weight
- (4) Lot number, batch identification and date of manufacture
- (5) Number and revision of this specification

6. NOTES

6.1 Intended use - This flexible, low density, open cell, polyester type polyurethane foam is intended for use in conjunction with MIL-H-81288 for shock cushioning and vibration absorption. Adhesive bonding of the foam to the mounting base metal parts is essential and the effective bond must be stronger than the foam itself. This material is not recommended

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for applications involving static loading where the static deflection exceeds ten per cent compression from unloaded foam thickness.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Grade required.
- c. Form required.
- d. Quantity desired.
- e. Level of packaging and packing required (see 5.1 and 5.2)
- f. Any special marking required.
- g. First article, when required (see 4.3.1 and 6.3).

6.2.2 Data requirements. When this specification is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Armed Services Procurement Regulations, the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of ASPR-7-104.9(n) are not invoked, the data specified below will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraphs:

<u>Paragraph</u>	<u>Data Requirement</u>	<u>Applicable DID</u>
4.3	First Article Inspection Reports	DI-T-5239-Inspection Test Reports

(Copies of data item descriptions required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

6.3 Contracts or orders shall specify the following provisions for the first article inspection:

6.3.1 Whether first article inspection is required When a contractor is in continuous production of the polyurethane foam from contract to contract, consideration should be given to waive the first article inspections. If inspection is required, indicate:

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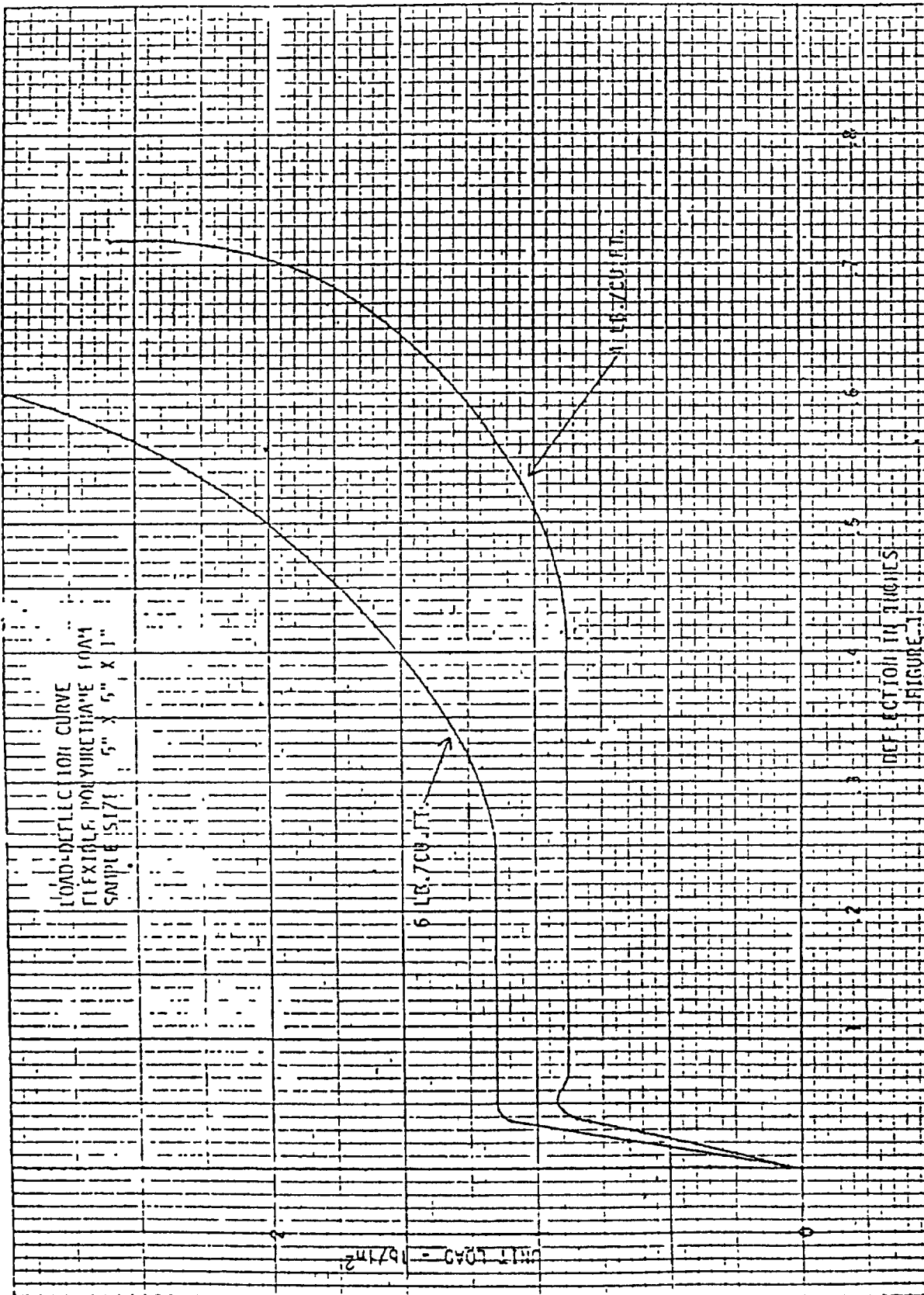
- a. Where the first article inspection is to be conducted (at the contractor's plant, Government or commercial laboratory).
- b. That the approval of first article samples or the waiving of the first article inspection shall not relieve the contractor of his obligation to fulfill all other requirements of the specification and contract.

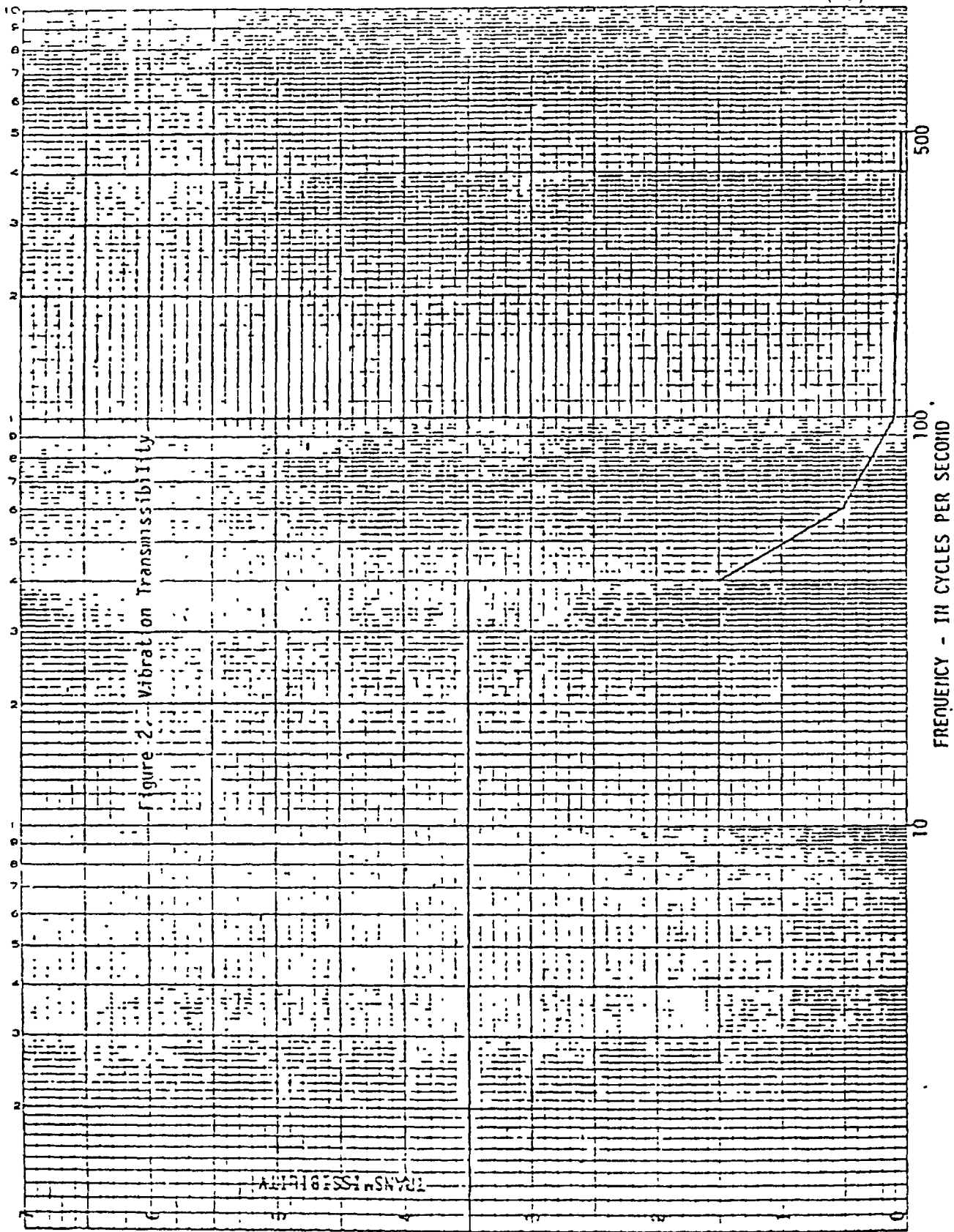
6.4 Uniform density. In order that users may be assured of uniform density across the foam sheet or pad, they should require the foam manufacturers to cut the foam horizontally with respect to the direction it is foamed.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

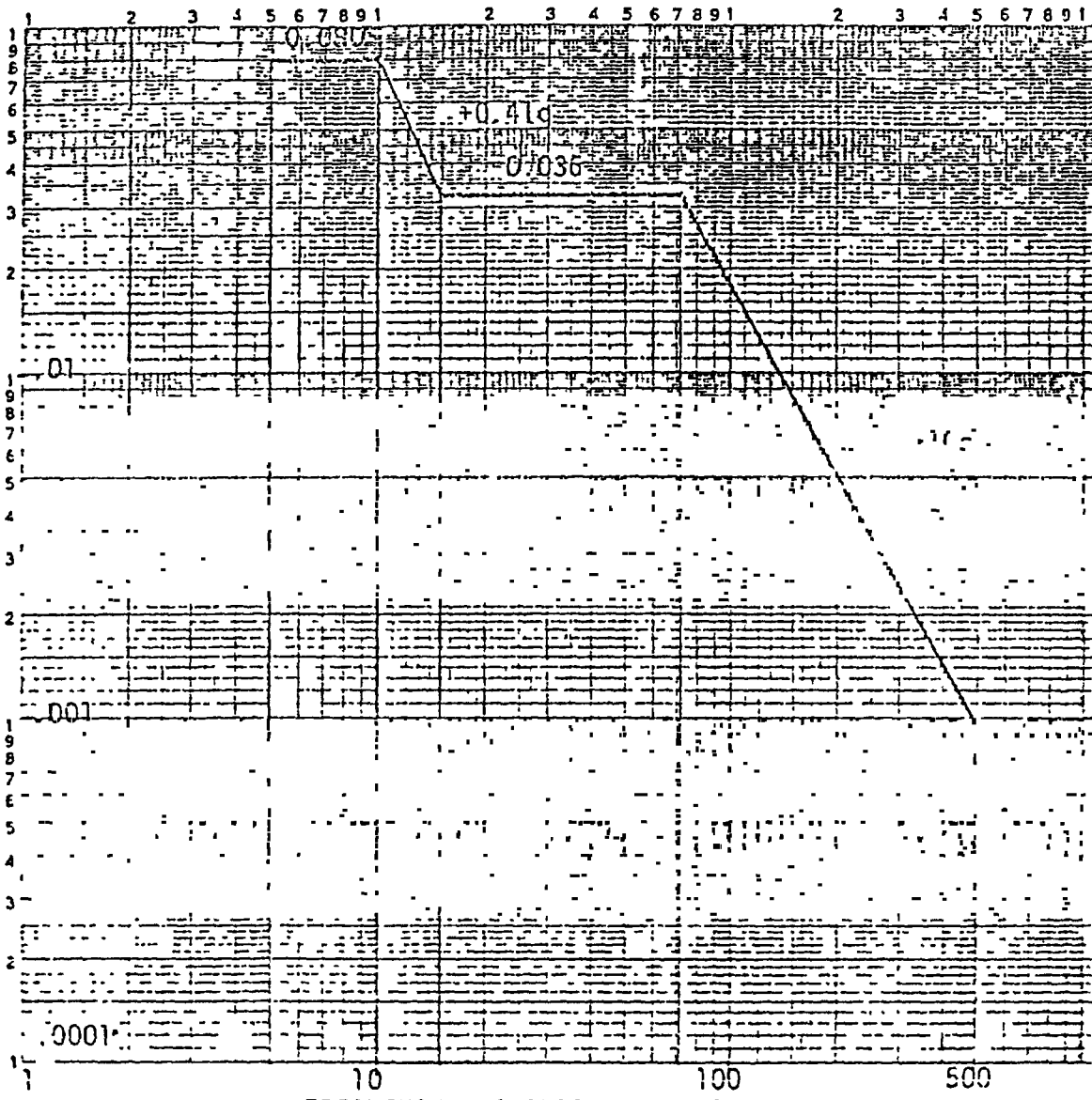
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Navy - AS
(Project No. 5340-N067)

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FREQUENCY - CYCLES PER SECOND

Figure 3. Applied Vibration

INSTRUCTIONS. In a continuing effort to make our standardization documents better, the DoD provides this form for submitting comments and suggestions for improvements. All users of military standardization documents are invited to submit suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (DO NOT STAPLE), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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